Hurford's constraint, the semantics of disjunction, and the nature of alternatives

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Abstract

This paper brings together two recent lines of work in which disjunction plays a prominent role, namely, on the one hand, work on so-called Hurford disjunctions, i.e., disjunctions where one disjunct entails another, and on the other hand, work in alternative and inquisitive semantics where disjunction has been argued to generate multiple propositional alternatives. We show that each of these lines of research is relevant to the other.

On the one hand, we point out that Hurford effects are found not only in disjunctive declaratives, but also in disjunctive questions. These cases are not covered by the standard accounts of Hurford phenomena, which crucially rely on a truth-conditional treatment of disjunction. We show that inquisitive semantics makes it possible to generalize these accounts, yielding a unified explanation of Hurford phenomena as they occur both in declaratives, and in questions—an advantage which is not shared by other theories of disjunction.

On the other hand, we discuss how Hurford effects provide an empirical handle on the subtle but fundamental differences existing between inquisitive semantics and alternative semantics, providing insight into the notion of meaning and the nature of alternatives in the two frameworks.

1 Introduction

Disjunction plays a prominent role in two recent lines of work in formal semantics and pragmatics. In each case, the focus has been on certain empirical phenomena that are not captured by standard semantic and pragmatic theories of disjunction, and these phenomena have been used to motivate some fundamental refinements of the standard view on meaning and the division of labor between semantics and pragmatics.

Hurford disjunctions. The first line of work is concerned with so-called Hurford disjunctions, which are disjunctions where one disjunct entails another (e.g., Hurford, 1974; Gazdar, 1979; Chierchia *et al.*, 2009, 2012; Katzir and Singh, 2013; Meyer, 2013, 2014; Fox and Spector, 2015). Based on examples like those in (1) below, Hurford suggested that such disjunctions are always infelicitous, a generalization that is now referred to as *Hurford's constraint.*

(1) a. #John is American or Californian.
b. #That painting is of a man or a bachelor.
c. #The value of x is different from 6 or greater than 6.

However, Gazdar (1979) noted many apparent counterexamples to this generalization:

(2) a. Mary read most or all of the books on this shelf.
b. John and Mary have three or four kids.
c. Mary is having dinner with John, with Bill, or with both.

In subsequent work, these observations have been accounted for as follows.[1] First, it has been proposed that the disjunctions in (1) are infelicitous because they involve *redundancy*, in the sense that the disjunction as a whole is equivalent with one of the individual disjuncts (Simons, 2001; Katzir and Singh, 2013; Meyer, 2013, 2014). Second, the contrast between the infelicitous cases in (1) and the felicitous ones in (2) has been accounted for in terms of *exhaustive strengthening*. The idea is that the weak disjuncts in (2), unlike those in (1), naturally receive an exhaustive interpretation (e.g., most $\rightsquigarrow$ most but not all, while American $\not\rightsquigarrow$ American but not Californian). Under such an exhaustive interpretation, the disjunction as a whole is no longer equivalent with one of the individual disjuncts, so Hurford's constraint is satisfied (Chierchia *et al.*, 2009, 2012; Fox and Spector, 2015).

Disjunction and semantic alternatives. The second line of work that we will consider has focused on disjunctions appearing in non-assertive contexts, e.g., in questions, imperatives, conditional antecedents, and in the scope of modal operators. It has been proposed that in all these environments, disjunction gives rise to *sets of propositional alternatives*.[2,3]

This has motivated a move from the classical truth-conditional notion of meaning to a more fine-grained notion, which does not associate a sentence with a single proposition, but rather with a set of propositions. Within this general line of work, two more specific approaches have been taken. On the first approach, originating in Hamblin (1973), the notion of a propositional alternative is taken to be a primitive notion, i.e., it is not characterized in terms of yet more basic notions. For any given sentence, the propositional alternatives associated with that sentence are simply determined by the rules of the compositional semantics that is given for the relevant fragment of the language. This take on propositional alternatives is characteristic for the framework of *alternative semantics* (Hamblin, 1973; Kratzer and Shimoyama, 2002; Alonso-Ovalle, 2006, a.o.).

On the second approach, taken in *inquisitive semantics* (e.g., Ciardelli *et al.*, 2013, 2015), the meaning of a sentence is identified with the conditions under which it is *supported* by a given *information state*, rather than the conditions under which it is true in a given world. For instance, a declarative sentence like Amy sang is supported by an information state s in case it follows from the information available in s that Amy sang. On the other hand, a question like Did Amy sing? is supported in s in case it either follows from the information available in s that Amy sang, or it follows from the information available in s that Amy didn't sing.

The meaning of a sentence in inquisitive semantics is the set of all information states in which the sentence is supported. An information state, in turn, is modeled as a set of possible worlds, i.e., a proposition, but now regarded as representing a body of information rather than the content of a sentence. The alternatives associated with a sentence are those information states that contain *just enough* information to support the sentence, i.e., information states that support the sentence and cannot be weakened without losing support. As a consequence, not just *any* set of propositions can be the set of alternatives associated with a sentence. In particular, suppose p contains strictly more information than q, i.e., $p \subset q$: then p and q cannot both contain just enough information to

[1] We only give a brief summary of the main ideas here. More details will be provided in Section 2.

[2] See, e.g., von Stechow (1991); Aloni and van Rooij (2002); Roelofsen and van Gool (2010); AnderBois (2011); Biezma and Rawlins (2012); Uegaki (2014); Roelofsen and Farkas (2015) on disjunctive questions and Simons (2005); Alonso-Ovalle (2006); Aloni (2007b); Aloni and Ciardelli (2013) on free choice effects in conditionals, modals, and imperatives. While free choice phenomena have also received various other treatments (e.g., Zimmermann, 2000; Geurts, 2005; Schulz, 2005; Aloni, 2007a; Fox, 2007; Klinedinst, 2009; Chemla, 2009; Franke, 2009; van Rooij, 2010), there is a rather broad consensus that in the domain of disjunctive questions, which is the focus of the present paper, a treatment of disjunction as generating sets of propositional alternatives is indispensable.

[3] To avoid confusion: the semantic notion of alternatives that is at stake here is different both from the notion of *focus alternatives* (Rooth, 1985) and from the notion of *scalar alternatives* (e.g., Horn, 1972; Chierchia *et al.*, 2012).

support a given sentence, and thus, they cannot both belong to the set of alternatives associated with it. Thus, while both alternative semantics and inquisitive semantics associate sentences with sets of alternatives, there is a subtle difference between the two frameworks.

Outline of the paper. The goal of the paper is to connect these two general lines of work, showing how each is relevant to the other. First, we observe that the patterns observed by Hurford and Gazdar do not only obtain in declarative statements but also in *questions*. For instance, the question in (3a) below is just as infelicitous as Hurford's declarative (1a), and (3b) is as felicitous as its declarative counterpart (2a).

(3) a. #Is John American, or Californian?
b. Did Mary read most of the books on this shelf, or all of them?

Clearly, we would hope—and expect—that these observations could be explained by the same general principles that have been proposed to explain the original observations, namely, a ban against redundant operations and the availability of exhaustive strengthening as a way of obviating such redundancy. However, whether such an explanation is possible crucially depends on the way the disjunction occurring in (3a,b) is analyzed. We will see that under the most widely adopted assumptions about the role of disjunction in questions, as found in alternative semantics and also in Karttunen's (1977) classical work on questions, the explanation does in fact *not* go through. By contrast, we will see that inquisitive semantics provides a setting in which it *is* possible to naturally extend the given explanation of Hurford effects to questions.

In the second part of the paper, we will see that this empirical discrepancy between inquisitive and alternative semantics is connected to more fundamental differences between these frameworks. We will show that there is a direct connection between the distinct predictions made in the domain of Hurford disjunctions and differences in the basic notions of meaning and propositional alternatives that underlie alternative and inquisitive semantics. In doing so, we hope to illustrate that the abstract logical features of a semantic framework can have very concrete empirical repercussions.

Thus, on the one hand we will show that an inquisitive account of disjunction makes it possible to obtain a more comprehensive account of Hurford phenomena, as they occur not only in statements but also in questions. On the other hand, we will find that Hurford disjunctions provide an empirical handle on the subtle but fundamental difference between the notions of meaning adopted in alternative and inquisitive semantics.

The paper is organized as follows. Section 2 prepares the ground by specifying a baseline theory of Hurford disjunctions in declarative statements in terms of redundancy and exhaustive strengthening, based on Simons (2001); Katzir and Singh (2013) and Chierchia *et al.* (2009, 2012). With this baseline theory in place, the paper proceeds in two parts. First, in Section 3, we discuss the relevance of inquisitive semantics for theories of Hurford disjunctions, showing that an inquisitive treatment of disjunction makes it possible to extend the baseline account to one that applies uniformly to Hurford disjunctions in statements and in questions. Second, in Section 4, we discuss the relevance of Hurford disjunctions for the architecture of alternative-based theories of meaning, showing in particular that they shed light on certain fundamental differences between inquisitive semantics and alternative semantics. Section 5 concludes.

2 Hurford's constraint, redundancy, and exhaustification

2.1 Hurford's constraint and redundancy

Why would Hurford's sentences in (1) be infelicitous? As mentioned above, an appealing hypothesis that has been proposed in the literature is that this has to do with *redundancy* (Simons, 2001; Katzir and Singh, 2013; Meyer, 2013, 2014). There are various ways to make this idea more precise. We will focus here on Katzir and Singh's (2013) proposal, which is as follows:[4]

(4) **Local redundancy principle (Katzir and Singh, 2013)**

A sentence is deviant in a context c if its logical form contains a node $\mathsf{O}(\mathsf{A},\mathsf{B})$ which is obtained by application of a binary operator O to two arguments A,B, and the outcome is semantically equivalent, relative to c, with one of the arguments on its own.

This principle is formulated in terms of a notion of contextual equivalence. Katzir and Singh take a context c to be a set of possible worlds, namely those worlds that are compatible with the information available in c, and define contextual equivalence as follows:[5]

(5) **Contextual equivalence (Katzir and Singh, 2013)**

Two sentential constituents A and B are equivalent relative to a context c just in case A and B are true in exactly the same worlds in c.

Let us first see how the local redundancy principle predicts Hurford's constraint for sentential disjunctions. After that, we will suggest a slight amendment in order to let the principle apply to sub-sentential disjunctions as well. Recall that, in standard truth-conditional semantics, the meaning of a sentence A is taken to be a proposition $|\mathsf{A}|$, which amounts to the set of worlds where the sentence is true. A sentence A entails a sentence B in case B is true whenever A is true, i.e., in case $|\mathsf{A}| \subseteq |\mathsf{B}|$. Moreover, sentential disjunction is taken to yield the union of two propositions, that is, $|\mathsf{or}(\mathsf{A},\mathsf{B})| = |\mathsf{A}| \cup |\mathsf{B}|$.

Now, suppose that the logical form of a sentence contains a node at which disjunction applies to two sentential constituents A and B, where $|\mathsf{A}| \subseteq |\mathsf{B}|$: then, $|\mathsf{or}(\mathsf{A},\mathsf{B})| = |\mathsf{A}| \cup |\mathsf{B}| = |\mathsf{B}|$. So, we have a node at which a binary operator yields an outcome which is semantically equivalent with one of the inputs. Thus, the given logical form breaches Katzir and Singh's local redundancy principle. In this way, Hurford's constraint is explained as a particular consequence of a more general ban against local redundancies.

[4] On Katzir and Singh's account, redundancy is not checked at a *global* level, i.e., at the level of a full utterance, but rather more *locally*, i.e., each time a complex constituent is formed by applying a binary operator to two arguments. Simons' proposal is very similar to Katzir and Singh's. Meyer (2013, 2014) on the other hand, derives Hurford's constraint from a more global redundancy principle. Her proposal crucially relies on the assumption that every declarative sentence involves a covert modal operator K, which is interpreted by default relative to the speaker's epistemic state. For instance, if Bill says "John left", then this sentence is parsed as [$\mathrm{K}_{\mathrm{Bill}}$ John left] and interpreted as saying that Bill believes that John left. This assumption clearly raises several thorny issues, e.g., concerning embedding and propositional anaphora. In particular, it is not clear how the account would extend to questions, which will be our main concern in the present paper. Evidently, if Bill asks "Did John leave?", this sentence cannot be parsed as [$\mathrm{K}_{\mathrm{Bill}}$ whether John left]. We therefore focus on Katzir and Singh's local redundancy account.

We should perhaps add that in our view, the global approach is not *a priori* more plausible or explanatory. It is true that this approach stands a better chance of being grounded in a Gricean maxim of Manner. But the local approach could similarly be grounded in a maxim that bans unnecessary processing complexities.

[5] The account of Simons (2001) differs from that of Katzir and Singh (2013) in that it assumes a notion of contextual equivalence which is not just sensitive to the *information* available in the given context, but also to the current *question under discussion*. Since this refinement is not relevant for our purposes here, we leave it out of consideration.

Notice that this explanation relies in a crucial way on the classical treatment of disjunction as forming the union of two propositions. In the next section, we will need to consider other treatments of disjunction, in order to make sense of occurrences of disjunction in alternative questions; crucially, we will see that not all of these treatments allow for a replication of Katzir and Singh's argument.

For simplicity, we have formulated the argument here without making reference to context. In many concrete cases, however, contextual background information plays a crucial role. To see this, consider (6) below, a version of Hurford's (1a) with full sentential disjuncts.

(6) #John is American or he is Californian.

This sentence is only infelicitous in a context in which it is known that being Californian implies being American. For someone who lacks this background knowledge, the sentence is acceptable. This is accounted for, because relative to a context where there is no background information on the relation between being Californian and being American, the disjunction John is American or he is Californian is not equivalent to any of its disjuncts, and is therefore not predicted to be infelicitous. On the other hand, relative to any context where it is known that being Californian implies being American, John is American or he is Californian *is* equivalent to one of the disjuncts, namely to John is American. In any such context the sentence is therefore predicted to be infelicitous.

2.2 A small amendment

Now let us return to Hurford's original example (1a), John is American or Californian, where the disjunction applies to two non-sentential constituents, American and Californian. In this case, Katzir and Singh's principle does not immediately apply, because contextual equivalence is only defined for sentential constituents. At first sight it may seem that this problem can be overcome simply by generalizing the notion of contextual equivalence to non-sentential constituents in the obvious way. That is, we may say that two constituents of arbitrary type are equivalent relative to a content c just in case they have the same extension in all worlds in c. In particular, the property-denoting constituents American and American or Californian would then be equivalent relative to a context c just in case the extensions of the two properties coincide in every world in c, which is just to say that it is known in c that being Californian implies being American. This would indeed suffice to deal with Hurford's example (1a).

However, there are other cases where this generalized notion of contextual equivalence does not suffice, and it is really the local redundancy principle itself that needs to be amended. Consider the following example:

(7) #Isabelle de Lusignan was a descendant of King William or his son.

The disjunction King William or his son is not contextually equivalent to either one of its disjuncts on any reasonable notion of contextual equivalence. However, relative to any context in which it is known that being a descendant of King William's son implies being a descendant of King William himself, the sentence in (7) as a whole *is* equivalent with one where the disjunction is replaced by just one of its disjuncts:

(8) Isabelle de Lusignan was a descendant of King William.

What this shows is that we cannot always determine whether a non-sentential disjunction is redundant just by looking at the disjunctive phrase itself. We have to look at the sentential constituent that the phrase is part of. Further confirmation of this point comes from the fact that the disjunction King William or his son is perfectly felicitous when part of other sentences, like (9).

(9) Isabelle de Lusignan was married to King William or his son.

These considerations lead us to the following generalized version of Katzir and Singh's local redundancy principle.

(10) **Generalized local redundancy principle**

A sentence is deviant in a context c if its logical form contains a node $\mathsf{O}(\mathsf{A},\mathsf{B})$ obtained by application of a binary operator O to two arguments A, B, such that, if S is the smallest sentential constituent containing $\mathsf{O}(\mathsf{A},\mathsf{B})$, then $\mathsf{S}[\mathsf{O}(\mathsf{A},\mathsf{B})]$ is equivalent, relative to c, with either $\mathsf{S}[\mathsf{A}]$ or $\mathsf{S}[\mathsf{B}]$.

2.3 Hurford's constraint and exhaustification

So far, we saw that a general ban against redundancy predicts the infelicity of Hurford disjunctions, thus accounting for the oddness of the sentences in (1). But is this prediction not too strong? What about Gazdar's apparent counterexamples to Hurdord's constraint in (2)? How to explain the felicity of these cases?

Chierchia *et al.* (2009, 2012) show that their grammatical theory of *exhaustive strengthening* accounts for the contrast between Hurford's examples in (1) and Gazdar's examples in (2). According to this theory, the logical form of a sentence may contain occurrences of a covert exhaustification operator, exh, which behaves similarly to only: it strengthens the meaning of the constituent to which it applies, making it exhaustive relative to the scalar alternatives for that constituent.

Now, in Gazdar's examples, the weak disjunct naturally receives an exhaustive interpretation, under which it is no longer entailed by the other disjunct.

(11) a. Mary read most of the books. $\rightsquigarrow$ not all
b. John and Mary have three kids. $\rightsquigarrow$ not four
c. Mary is having dinner with John. $\rightsquigarrow$ not with Bill, Sue, ...

By contrast, the weak disjuncts in Hurford's examples can*not* receive such a strengthened interpretation.

(12) a. John is American. $\not\rightsquigarrow$ not Californian
b. That painting is of a man. $\not\rightsquigarrow$ not a bachelor
c. The value of x is different from 6. $\not\rightsquigarrow$ not greater than 6

These observations provide the basis for an explanation of the contrast between (1) and (2). To see this, consider first a Hurford disjunction A or B of the felicitous kind exemplified in (2), where A is the weak disjunct, and B the strong one. One possible logical form for the disjunction is simply $\mathsf{or}(\mathsf{A},\mathsf{B})$, which is ruled out by the local redundancy principle. However, the grammatical theory of exhaustive strengthening allows for another logical form, namely $\mathsf{or}(\mathsf{exh}(\mathsf{A}),\mathsf{exh}(\mathsf{B}))$, in which the disjuncts are exhaustified prior to the application of disjunction. Now, in each of the examples in (2), $\mathsf{exh}(\mathsf{A})$ is incompatible with B, and thus, a fortiori, it is incompatible with $\mathsf{exh}(\mathsf{B})$. Since both $\mathsf{exh}(\mathsf{A})$ and $\mathsf{exh}(\mathsf{B})$ are consistent, this ensures that there is no entailment between $\mathsf{exh}(\mathsf{A})$ and $\mathsf{exh}(\mathsf{B})$. Thus, the logical form $\mathsf{or}(\mathsf{exh}(\mathsf{A}),\mathsf{exh}(\mathsf{B}))$ satisfies the local redundancy principle, which accounts for the fact that the sentence is perceived as felicitous.[6]

Now consider a Hurford disjunction A or B of the infelicitous kind exemplified in (1). Again, the basic logical form $\mathsf{or}(\mathsf{A},\mathsf{B})$ is incompatible with the local redundancy principle. Moreover, in

[6] The logical forms $\mathsf{or}(\mathsf{exh}(\mathsf{A}),\mathsf{B})$ and $\mathsf{or}(\mathsf{A},\mathsf{exh}(\mathsf{B}))$ also seem to be allowed by Chierchia *et al.* (2009). We disregard them here, but our discussion does not hinge on this in any way.

this case exhaustification does not improve the situation, leaving the meanings of the disjuncts unchanged.[7] As a consequence, the second logical form available for the sentence, $\mathsf{or}(\mathsf{exh}(\mathsf{A}), \mathsf{exh}(\mathsf{B}))$, violates the local redundancy principle as well. Thus, in this case no logical form for the sentence satisfies the redundancy principle, which explains why the sentence is perceived as infelicitous.

Notice that, besides discriminating in a principled way between felicitous and infelicitous Hurford disjunctions, the theory of Chierchia *et al.* (2009, 2012) also makes a particular prediction about the interpretation of felicitous Hurford disjunctions. Namely, it predicts that the only available interpretation for such a disjunction is one in which the disjuncts are interpreted exhaustively. This turns out to be correct. Consider the following example from Chierchia *et al.* (2009).

(13) Either John solved two exercises, or he solved all of them.

This sentence is unambiguously false if John solved exactly three out of five exercises. This witnesses that, indeed, only the reading $\mathsf{or}(\mathsf{exh}(\mathsf{A}), \mathsf{exh}(\mathsf{B}))$ is available for the sentence, and not the reading $\mathsf{or}(\mathsf{A}, \mathsf{B})$, under which the sentence would be true if John solved three out of five exercises.

So, the seemingly puzzling data concerning the felicity and interpretation of Hurford disjunctions have a perspicuous explanation under the assumption that (i) there is a ban against the application of disjunction to two arguments one of which entails the other, rooted in a more general ban against redundancy, and (ii) exhaustification of the weaker disjunct can, in some cases, break the entailment and render the stronger disjunct non-redundant after all.[8]

3 Relevance of inquisitive semantics for Hurford phenomena

3.1 Empirical observation: Hurford effects in questions

Work on Hurford effects has focused so far on declarative sentences. However, the same effects occur in questions as well. Alternative questions corresponding to the infelicitous disjunctive declaratives in (1) are equally infelicitous:

(14) a. #Is John American, or Californian?
b. #Is that painting of a man, or of a bachelor?
c. #Is the value of x different from 6, or greater than 6?

On the other hand, alternative questions corresponding to the acceptable disjunctive declaratives in (2) are acceptable as well:

(15) a. Did Mary read most of the books on this shelf, or all of them?
b. Do John and Mary have three kids, or four?
c. Is Mary having dinner with John, with Bill, or with both?

Thus, the contrast exhibited by disjunctive declaratives extends to questions: a Hurford-type alternative question is felicitous only if the weak disjunct may be given an exhaustive interpretation so as to break the entailment.

[7] This may be due to the fact that the relevant items are not scalar items, or it may be due to the particular structure of the space of scalar alternatives. For instance, if the stronger alternatives to *American* include *Californian*, *Texan*, etc., then these alternatives fully exhaust the denotation of the predicate. It is thus impossible to conjoin the predicate with the negation of the stronger alternatives without ending up with a contradiction (cf., Fox, 2007; Singh, 2008).

[8] The theory of Chierchia *et al.* (2009, 2012) has been extended in Fox and Spector (2015) to account for some additional empirical issues concerning Hurford disjunctions, first discussed by Singh (2008) and Gajewski and Sharvit (2012). Since these issues are orthogonal to our concerns in the present paper, we do not discuss this work in detail.

Moreover, we saw above that if a Hurford disjunction is felicitous, its unique interpretation is the one resulting from an exhaustive interpretation of the disjuncts. This is also true for Hurford-type alternative questions. For instance, the question in (16) presupposes that John solved either exactly two exercises, or all of the exercises, and it asks which of these two possibilities holds.

(16) Did John solve two of the exercises, or all of them?

What these data show is that Hurford's constraint, i.e., the ban against application of disjunction to two arguments one of which entails the other, concerns disjunction *in general*: not only when it occurs in declaratives, but also when it is used to form questions. The assumption that such a general ban is in force, together with Chierchia *et al.*'s grammatical theory of exhaustive strengthening, accounts for the observations in (14)–(16).[9]

However, the important question that remains to be addressed is whether the general redundancy principle which was taken to explain the existence of Hurford's constraint in declaratives carries over to alternative questions as well. It is not obvious that it does, because the redundancy-based explanation of Hurford's constraint in declaratives crucially relied on disjunction being interpreted as the operation that yields the union of two propositions. Clearly, this cannot be the role that disjunction plays in the formation of alternative questions: in this case, the propositions expressed by the two disjuncts are not merged into one, but rather—it seems—they are kept apart, each contributing a separate alternative to the meaning of the question.

This idea has been implemented in the literature in various ways. In Section 3.2 we will discuss the traditional treatment of disjunction in questions, rooted in Hamblin (1973) and Karttunen (1977). In Section 3.3, we will discuss the treatment of disjunction in inquisitive semantics, which is different in a subtle but crucial way. We will see that the inquisitive treatment of disjunction allows for a uniform redundancy-based account of Hurford effects across declaratives and questions—a feature which is not shared by the more traditional treatment.

3.2 Traditional accounts of disjunction in questions do not derive HC

In traditional accounts of alternative questions, disjunction is taken to collect the propositions expressed by the two disjuncts into a set. In turn, we can distinguish two ways to cash out this idea. The most straightforward implementation is cast within the framework of *alternative semantics* (Hamblin, 1973). In this framework, a basic clause such as $\mathsf{Amy\ sang}$ denotes a singleton set consisting of the proposition that is classically associated with the clause: $[\![\mathsf{A}]\!] = \{|\mathsf{A}|\}$. Disjunction is still taken to perform union (see Alonso-Ovalle, 2006), but now at the level of these sets of propositions. So, for a disjunction of two basic clauses A and B, we get:

$$[\![\mathsf{A\ or\ B}]\!] = \{|\mathsf{A}|\} \cup \{|\mathsf{B}|\} = \{|\mathsf{A}|, |\mathsf{B}|\}$$

[9] One may perhaps suspect that in the particular domain of questions, Hurford effects could also be explained in terms of the interaction between information asked and information presupposed. It is often assumed that a question comes with the presupposition that one of its possible answers is true (Belnap, 1966, among many others). In alternative questions like those in (14), this presupposition is enough to actually establish one of the answers to the question. Thus, a speaker asking such a question would be presupposing enough information to actually resolve the question, which seems to be sufficient reason to regard the question as deviant. However, this explanation does not carry over to Hurford-type alternative questions with more than two disjuncts, such as (i).

(i) #Is John Russian, American, or Californian?

This question is as odd as its two-disjunct counterpart, (14a). However, in this case, the presupposition of the question does not establish any particular answer. Thus, the suggested argument would not explain the infelicity of this question.

This treatment of disjunction is central to several accounts of alternative questions, such as von Stechow (1991); Roelofsen and van Gool (2010); Biezma and Rawlins (2012); Uegaki (2014).

A different implementation of the same idea is found in the classical theory of questions of Karttunen (1977). This theory follows Montague (1973) in taking semantic composition to yield primarily the *extension* $[\![\mathsf{A}]\!]_w$ of an expression relative to a possible world. As usual, the extension of a sentential expression is taken to be a truth-value. Moreover, Karttunen assumes an operator '?' which turns such an expression into what he calls a *proto-question*. The semantic effect of this operator can be defined as follows:

$$[\![?\mathsf{A}]\!]_w = \begin{cases} \{|\mathsf{A}|\} & \text{if } w \in |\mathsf{A}| \\ \emptyset & \text{if } w \notin |\mathsf{A}| \end{cases}$$

In Karttunen's account of alternative questions, too, disjunction performs union; however, this union only takes place after the proto-question operator has applied to each disjunct. The extension of the resulting question is as follows.

$$[\![?\mathsf{A} \text{ or } ?\mathsf{B}]\!]_w = [\![?\mathsf{A}]\!]_w \cup [\![?\mathsf{B}]\!]_w = \{p \in \{|\mathsf{A}|, |\mathsf{B}|\} \mid w \in p\}$$

Thus, an alternative question receives essentially the same denotation as in Hamblin-style theories, except that this denotation is relativized to a particular world, and propositions which are false at this world are left out.

Now let us return to our main concern, Hurford effects. Assuming either of these classical accounts of disjunction in questions, does the explanation of Hurford's constraint in terms of local redundancy carry over to questions?

Consider first the simpler approach couched in alternative semantics. Suppose A strictly entails B, that is, $|\mathsf{A}| \subset |\mathsf{B}|$. Then the meaning of the whole disjunction, $[\![\mathsf{A} \text{ or } \mathsf{B}]\!] = \{|\mathsf{A}|, |\mathsf{B}|\}$, contains two alternatives, and is therefore distinct from the meaning of each of the two disjuncts. Under this analysis, then, the derivation of the meaning of a question like those in (14) does not involve any redundant operation. Thus, the infelicity of such questions is left unexplained.

Now consider Karttunen's approach. Clearly, the redundancy constraint cannot be imposed directly at the level of extensions, lest we predict redundancy for any declarative disjunction with two true or two false disjuncts. Rather, the constraint should be taken to apply at the level of *intensions*. But even if A entails B, the intension predicted by Karttunen for the disjunction $?\mathsf{A}$ or $?\mathsf{B}$ is bound to be different from the intensions of the arguments $?\mathsf{A}$, $?\mathsf{B}$. So, on this theory too, Hurford-type alternative questions involve no redundancy, and their infelicity is not predicted.

We conclude that, given traditional treatments of disjunction in questions, the account of Hurford effects in terms of redundancy does *not* carry over to disjunctive questions. Thus, the observations made in the previous section are left unexplained.

This may be taken to cast doubt on the redundancy-based explanation of Hurford effects in disjunctive statements. After all, it might seem that this explanation only covers one particular manifestation of a more general phenomenon. However, in the next section we will show that this problem no longer arises if we replace the traditional treatment of disjunction in questions with the treatment proposed in inquisitive semantics. We will see that Hurford effects *can* in fact be given a general redundancy-based explanation, regardless of the environment in which they occur.[10]

[10] As one reviewer suggested to us, one may try to rescue traditional theories of disjunction by replacing full-fledged semantic equivalence with a notion of equivalence modulo presupposition, and then relying on the *exactly-one* presupposition which is usually associated with alternative questions (see, e.g., Biezma and Rawlins, 2012). Notice however that an explanation along these lines, to the extent that it can be made to work, would not be applicable to disjunctive declaratives, which do not have an *exactly-one* presupposition. So, this approach would lead to two

3.3 Inquisitive semantics

Basic notions. Standardly, the meaning of a sentence is identified with its truth-conditions with respect to a world. This view on meaning is limited, however: in particular, it is not suitable to analyze questions. In inquisitive semantics the fundamental notion of truth at a world is replaced with the notion of *support relative to an information state*, where information states are modeled as sets of possible worlds. Intuitively, a declarative sentence is supported by an information state if this state contains enough information to establish that the sentence is true, while a question is supported by an information state if this state contains enough information to resolve the question.

The proposition expressed by a sentence in truth-conditional semantics is modeled as a set of worlds—the set of worlds where the sentence is true. Similarly, in inquisitive semantics the proposition expressed by a sentence is modeled as a set of information states—those states that support the sentence. The *alternatives* associated with a sentence A are those information states that *minimally* support A, that is, those states s that support A and cannot be weakened without losing support.

(17) $\textsc{alt}(\mathsf{A}) = \{s \in [\![\mathsf{A}]\!] \mid \text{ there is no } t \in [\![\mathsf{A}]\!] \text{ such that } t \supset s\}$

Let us illustrate the approach by means of two examples. First, consider a basic declarative sentences like Amy sang. This sentence is supported in a state s if it follows from the information available in s that Amy sang; formally, this means that s must be included in the set $|\mathsf{Amy\ sang}|$ of possible worlds where Amy sang. Thus, the proposition expressed by this sentence in inquisitive semantics is the following set of information states:[11]

(18) $[\![\mathsf{Amy\ sang}]\!] = \{s \mid s \subseteq |\mathsf{Amy\ sang}|\}$

This meaning has a unique maximal element—a unique alternative—namely the set $|\mathsf{Amy\ sang}|$.

(19) $\textsc{alt}(\mathsf{Amy\ sang}) = \{|\mathsf{Amy\ sang}|\}$

As a second example, consider the polar question Did Amy sing?. This question is supported in a state s if s contains enough information to establish whether Amy sang; this holds if it follows from the information available in s that Amy sang—i.e., if $s \subseteq |\mathsf{Amy\ sang}|$—or if it follows from the information in s that Amy didn't sing—i.e., if $s \subseteq |\mathsf{Amy\ didn't\ sing}|$. Thus, we have:

(20) $[\![\mathsf{Did\ Amy\ sing?}]\!] = \{s \mid s \subseteq |\mathsf{Amy\ sang}| \text{ or } s \subseteq |\mathsf{Amy\ didn't\ sing}|\}$

In this case, our meaning does not contain a unique alternative; rather, it contains two distinct alternatives, which correspond to the two ways in which the question can be minimally resolved.

(21) $\textsc{alt}(\mathsf{Did\ Amy\ sing?}) = \{|\mathsf{Amy\ sang}|, |\mathsf{Amy\ didn't\ sing}|\}$

Inquisitive disjunction. Like in truth-conditional semantics and alternative semantics, so also in inquisitive semantics disjunction is taken to perform *union*. To see how this operation fares

different explanations for what seems to be a single phenomenon, manifested in exactly the same way in declaratives and interrogatives. By contrast, we will provide a uniform redundancy-based explanation of Hurford effects, which applies across both sentence types.

[11] As we will make explicit below, the logical form we assume for the declarative sentence under consideration here is [$\mathrm{C_{dec}}$ [Amy sang]], where $\mathrm{C_{dec}}$ is a clause type marker which determines the word order and affects the prosody of the sentence. Semantically, $\mathrm{C_{dec}}$ is vacuous when applied to a simple clause like Amy sang, but, as we will see, not when applied to a disjunctive clause like Amy sang or danced.

in the inquisitive setting, consider the disjunctive phrase Amy sang or Amy danced. The meaning assigned to this phrase is:

(22)
$$
\begin{aligned}
[\![\textsf{Amy sang or Amy danced}]\!] &= [\![\textsf{Amy sang}]\!] \cup [\![\textsf{Amy danced}]\!] \\
&= \{s \mid s \subseteq |\textsf{Amy sang}|\} \cup \{s \mid s \subseteq |\textsf{Amy danced}|\} \\
&= \{s \mid s \subseteq |\textsf{Amy sang}| \text{ or } s \subseteq |\textsf{Amy danced}|\}
\end{aligned}
$$

This set of information states contains two alternatives, namely $|\textsf{Amy sang}|$ and $|\textsf{Amy danced}|$.

(23) $\textsc{alt}(\textsf{Amy sang or Amy danced}) = \{|\textsf{Amy sang}|, |\textsf{Amy danced}|\}$

The alternatives for this disjunctive phrase are depicted in Figure 1(a), where 11 is a world in which Amy sang and danced, 10 a world in which she sang but did not dance, and so on. In general, whenever disjunction applies to two simple clauses that are logically independent (i.e., neither one entails the other) the resulting meaning contains two alternatives, each of which corresponds to the proposition expressed by one of the disjuncts in standard truth-conditional semantics.

This shows that in inquisitive semantics, just like in alternative semantics, disjunction has the potential to 'collect' the alternatives associated with the two disjuncts, without collapsing them into one. This is what makes it possible to account for the role of disjunction in alternative questions.

Hurford disjunctions are redundant in inquisitive semantics. Let us now consider a Hurford disjunction, such as Amy danced or Amy moved, where $|\textsf{Amy danced}| \subseteq |\textsf{Amy moved}|$. Now any information state s which is included in $|\textsf{Amy danced}|$ must also be included in $|\textsf{Amy moved}|$. So, the information states which are included in $|\textsf{Amy danced}|$ or in $|\textsf{Amy moved}|$ are simply those which are included in $|\textsf{Amy moved}|$. We thus have:

(24)
$$
\begin{aligned}
[\![\textsf{Amy danced or Amy moved}]\!] &= \{s \mid s \subseteq |\textsf{Amy danced}|\} \cup \{s \mid s \subseteq |\textsf{Amy moved}|\} \\
&= \{s \mid s \subseteq |\textsf{Amy danced}| \text{ or } s \subseteq |\textsf{Amy moved}|\} \\
&= \{s \mid s \subseteq |\textsf{Amy moved}|\} \\
&= [\![\textsf{Amy moved}]\!]
\end{aligned}
$$

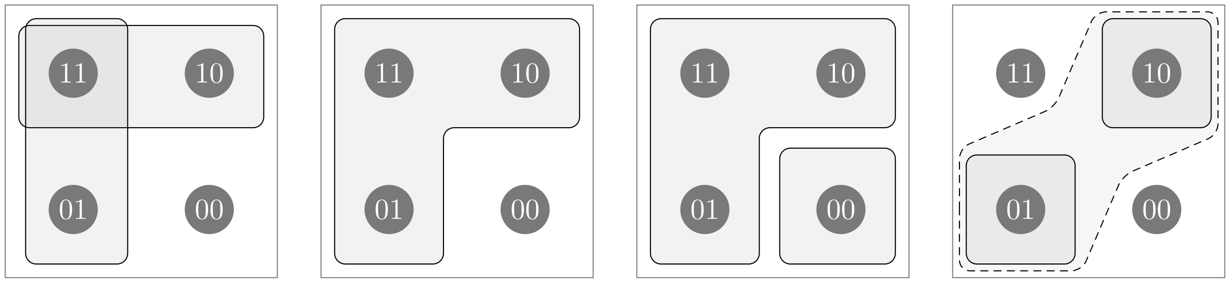
This shows that, in inquisitive semantics, disjoining two clause one of which entails the other is a redundant operation. As a consequence, if we combine inquisitive semantics with Katzir and Singh's redundancy principle, we predict that a logical form is always infelicitous if it contains a node at which disjunction applies to two arguments one of which entails the other.[12] Thus, Hurford's constraint is derived.

A uniform account of HC across disjunctive environments. What exactly have we just shown: that Katzir and Singh's explanation of Hurford constraint in declaratives can be replicated in inquisitive semantics, or that the inquisitive treatment of disjunction together with Katzir and Singh's redundancy principle yield an explanation for Hurford's constraint in alternative questions? The answer is: *both*. Let us see why.[13]

We assume, with Katzir and Singh, that Hurford's constraint is to be explained in terms of a *local* notion of redundancy. That is, we assume that redundancy in Hurford disjunctions is detected at the level of the smallest sentential constituent containing the disjunctive phrase, regardless of whether

[12] The same argument applies to *contextual* Hurford disjunctions, provided that we replace Katzir and Singh's notion of contextual equivalence with its inquisitive counterpart: A and B are equivalent relative to a context c if and only if they are supported by exactly the same information states $s \subseteq c$.

[13] Thanks to an anonymous reviewer for prompting us to address this question more explicitly.



(a) ⟦sang or danced⟧ (b) ⟦$\mathrm{C_{dec}}$ [sang or danced]⟧ (c) ⟦$\mathrm{C_{pol}}$ [sang or danced]⟧ (d) ⟦$\mathrm{C_{alt}}$ [sang or danced]⟧

Figure 1: A bare disjunctive phrase and three types of disjunctive sentences formed out of it.

this constituent is part of a declarative or an interrogative construction. Now, while theories such as Karttunen's distinguish two distinct entries for disjunction—a declarative and an interrogative one—in inquisitive semantics disjunction is taken to make the same semantic contribution across all the contexts in which it occurs. The difference between various kinds of disjunctive sentences arises not from ambiguity, but rather from various syntactic and intonational features, each of which makes a specific semantic contribution.

For the sake of concreteness, we will provide an explicit illustration of how the meaning of various kinds of disjunctive sentences can be derived from the core meaning that inquisitive semantics assigns to a disjunctive phrase. The details of these derivations are to a large extent immaterial for our present purposes: the important point is that the same inquisitive disjunction operator is taken to be at play in all the relevant sentence types, and that by detecting redundancy at the level of the smallest sentential constituent containing this disjunction operator we obtain a general redundancy-based explanation of Hurford effects across declarative and interrogative constructions.

In English and many other languages, the interpretation of a disjunctive sentence depends on factors which include clause type marking (e.g., declarative/interrogative word order) and intonation (e.g., pitch contour, prosodic phrase structure). This is illustrated in (25)-(27) below, where ↑ and ↓ indicate rising and falling pitch contours, respectively, and hyphenation and commas indicate the absence and presence of prosodic phrase breaks, respectively:[14,15]

(25) Amy sang-or-danced↓. [disjunctive declarative]

(26) Did Amy sing-or-dance↑? [disjunctive polar question]

(27) Did Amy sing↑, or dance↓? [alternative question]

While these three disjunctive sentences contain exactly the same lexical material, they receive different interpretations. The disjunctive declarative in (25) provides the information that Amy sang or danced, and does not raise any issue. The disjunctive polar question in (26) does not provide any information, but does raise an issue which can be resolved by establishing that Amy sang or danced, or by establishing that she didn't do either. Finally, the alternative question in (27) presupposes that Amy either sang or danced, and raises an issue which can be resolved by

[14] A rough indication of the relevant intonation patterns suffices for our purposes here; for a more detailed description and experimental work on the intonation of disjunctive sentences see Bartels (1999); Pruitt and Roelofsen (2013).

[15] Besides disjunctive polar questions and alternative questions, exemplified in (26) and (27), there is one other type of disjunctive questions, which has a prosodic phrase break after the first disjunct, just like alternative questions and unlike polar disjunctive questions, but *rising* intonation on both disjuncts, unlike alternative questions. To simplify the discussion we do not explicitly take such questions into consideration here; see, e.g., Roelofsen and van Gool (2010); Pruitt and Roelofsen (2011); Roelofsen and Farkas (2015).

establishing which of the two things she did.

We will sketch a way to derive these different interpretations in inquisitive semantics, under the assumption that the sentences in (25)-(27) all contain the same disjunctive phrase, Amy sang or danced, but involve different clause type operators, which we will denote as C_{dec}, C_{pol}, and C_{alt}, respectively. So, syntactically (25)-(27) are represented as follows:

(28) [C_{dec} [Amy sang or danced]]

(29) [C_{pol} [Amy sang or danced]]

(30) [C_{alt} [Amy sang or danced]]

These representations are simplistic, but suffice to illustrate how the inquisitive treatment of disjunction allows us to derive the meaning of various types of disjunctive sentences in a uniform way, and which other semantic operations, besides the disjunction operator itself, may be taken to play a role in the interpretation of these sentences. While a full account of disjunctive sentences should specify how these additional semantic operations are connected to the various syntactic and intonational differences between (25)-(27), it suffices for our purpose here to assume that these operations are all 'packed into' C_{dec}, C_{pol}, and C_{alt}.[16]

We may assume that C_{dec} 'merges' the two alternatives generated by the disjunction into one big alternative, consisting of all worlds where Amy either sang or danced. Thus, the meaning of the declarative (25) is the one depicted in Figure 1(b). Similarly, we may assume that C_{pol} also merges the two alternatives generated by the disjunction into one big alternative, and then adds the complement of this alternative, which consists of all worlds where Amy neither sang nor danced. Thus, the meaning of (26) is depicted in Figure 1(c). Finally, we may assume that C_{alt} strengthens both alternatives in such a way that they become mutually exclusive (removing the overlap between them), and that it further adds a presupposition that one of these strengthened alternatives holds. Thus, the meaning of (27) is depicted in Figure 1(d), where the dashed boundary represents the presupposition of the question.[17]

Thus, the meaning of different types of disjunctive sentences—disjunctive declaratives, disjunctive polar questions, and alternative questions—can be derived based on a uniform treatment of disjunction, i.e., without assuming that *or* means different things in different types of sentences. Rather, the variation in meaning results from the different clause type markers, which are connected to the variation in word order and intonation between the relevant sentence types.[18]

Now, let us stress once more the importance of this fact for our current concerns: as we saw, when the inquisitive disjunction operator is applied to two arguments one of which entails the other, the result is simply equivalent to the weaker disjunct. Thus, a disjunction in a Hurford configuration is always redundant, regardless of the particular kind of construction in which it occurs. Assuming a ban against redundant operations, this provides a uniform explanation for the general oddness of Hurford disjunctions across disjunctive declaratives and interrogatives.[19]

[16] For a more 'unpacked' version of the account, we refer to Roelofsen (2013b); Roelofsen and Farkas (2015).

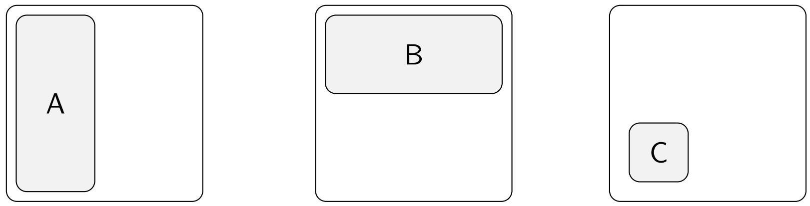
[17] This existential presupposition may be assumed to be part of any interrogative sentence, though whenever the alternatives generated by the sentence cover the entire set of possible worlds—as is the case, e.g., for the disjunctive polar question in (26)—the existential presupposition will be trivial.

[18] Note that such a uniform account is not possible if we assume the standard truth-conditional treatment of disjunction, where the semantic value of a disjunctive clause is a single proposition, without any trace of what was contributed by each individual disjunct. This would be sufficient to derive the meaning of a disjunctive declarative and that of a disjunctive polar question, but not to derive the meaning of an alternative question. The semantic value that C_{alt} takes as its input should make it possible to recognize the contribution of each individual disjunct.

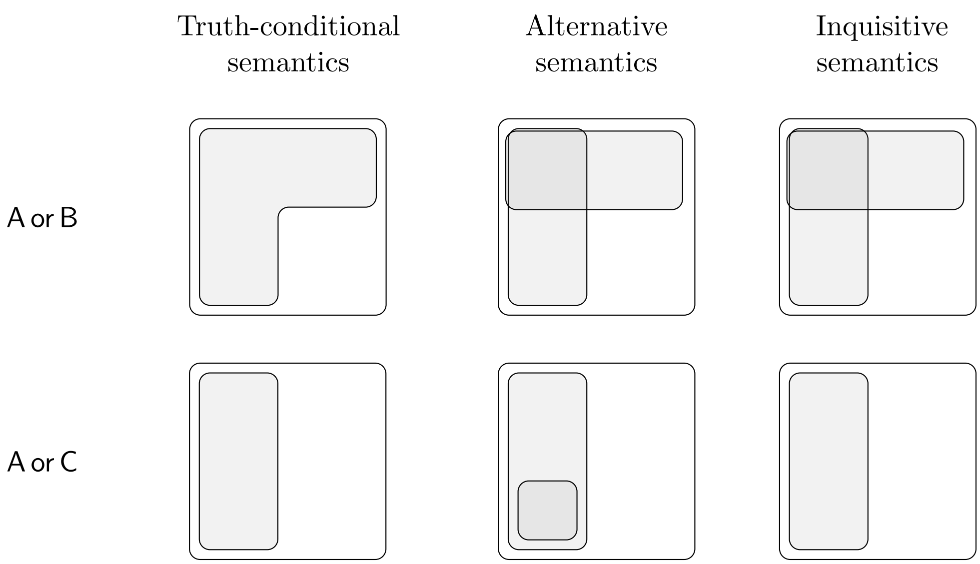
[19] Hurford's constraint is also operative in imperatives:

3.4 Comparison

The ways in which truth-conditional semantics, alternative semantics, and inquisitive semantics differ in their treatment of disjunction can be illustrated pictorially as follows. Suppose that A, B, and C are basic clauses expressing the following propositions, where the outer square represent the entire logical space, and the shaded areas represent the sets |A|, |B|, and |C|, respectively.



Notice that A and B are logically independent, while C entails A and is inconsistent with B. Now consider the non-Hurford disjunction A or B and the Hurford disjunction A or C. The figure below represents the meaning of these disjunctions in truth-conditional semantics, alternative semantics, and inquisitive semantics. In the case of truth-conditional semantics, we depict the proposition expressed, while in the case of alternative and inquisitive semantics, we depict the relevant set of alternatives.



In the case of the non-Hurford disjunction A or B, alternative semantics and inquisitive semantics yield the same result, differing from truth-conditional semantics: the propositions expressed by the two disjuncts surface as distinct alternatives. In the case of the Hurford disjunction A or C, however, inquisitive semantics patterns with truth-conditional semantics rather than with alternative

(i) a. #Get an American or a Californian to do this job!
b. #Find me a man or a bachelor!
c. #Let the value of x be different from 6 or greater than 6.

It has been argued that, in order to account for free-choice effects, disjunction in imperatives has to be treated as generating multiple alternatives, just like in alternative questions (Aloni, 2007b; Aloni and Ciardelli, 2013). This idea can be implemented in inquisitive semantics, which would allow us to explain Hurford effects like those in (i) exactly in the same way as Hurford effects in declaratives and interrogatives.

semantics: the proposition expressed by the stronger disjunct, C, does not surface as a separate alternative, and the disjunction as a whole is equivalent with the weak disjunct A.

Thus, inquisitive semantics strikes a balance between truth-conditional semantics and alternative semantics. On the one hand, if we disjoin two logically independent sentences in inquisitive semantics, the disjunction does not conflate the propositions expressed by the two, but it keeps them apart as distinct alternatives. This feature, shared by alternative semantics but not by truth-conditional semantics, is needed to account for the role of disjunction in alternative questions. On the other hand, if one disjunct entails the other, then the disjunction as a whole is equivalent with the weaker disjunct. This feature, shared by truth-conditional semantics but not by alternative semantics, is needed for an explanation of Hurford's constraint in terms of redundancy. The situation is summarized in the following table.

	Truth-conditional disjunction	Alternative Semantics disjunction	Inquisitive Semantics disjunction
Suitable to analyze alternative questions	no	yes	yes
Hurford disjunctions are redundant	yes	no	yes

3.5 Some further predictions

3.5.1 Contextually ruled out disjuncts

Combining a redundancy-based account of Hurford effects with inquisitive semantics also allows us to explain another interesting generalization: if a disjunction contains a disjunct which is inconsistent with the information available in a context c, then that disjunction is infelicitous in c.[20] This is true for disjunctive statements and disjunctive questions alike. As an illustration, consider (31).

(31) Context: Two friends have been following the worldcup together and it is common knowledge among them that the two finalists are Argentina and Germany. Before the match takes place, one says to the other:

a. #Believe me: the winner will be Argentina or Brazil.
b. #What do you think: will the winner be Argentina, Germany, or Brazil?

Both (31a) and (31b) seem very odd. What is responsible for this?

Even though this does not seem to have been noted in previous literature, both (31a) and (31b) are in fact limit cases of contextual Hurford disjunctions. To see why, consider first the statement in (31a), and let A and B stand for the two disjuncts of this statement. The context c described in the examples contains no worlds in which Brazil wins the world cup; thus, we have $|\mathsf{B}| \cap c = \emptyset$. Since the empty set is a subset of any other set, we have $|\mathsf{B}| \cap c \subseteq |\mathsf{A}| \cap c$, that is, B contextually entails A. Thus, (31a) is a contextual Hurford disjunction, and its oddness can be given a simple explanation: (31a) is odd because it involves a redundant disjunct.

This prediction is independent of whether we adopt a truth-conditional view on meaning or an inquisitive one. However, inquisitive semantics makes it possible to extend the same explanation

[20]We thank an anonymous reviewer for drawing our attention to this fact.

to the question in (31b). In this case, too, the last disjunct contextually entails the other disjuncts and is therefore redundant. Thus, the oddness of (31b) is also explained.

3.5.2 Conjunctions

Hurford's constraint is a generalization about disjunctions. However, the principles that have been proposed to account for it are not specific to disjunction: they are general principles of structural economy, and as such they have repercussions for other operators as well. For instance, Katzir and Singh note that their constraint also predicts the oddness of conjunctions in which one conjunct entails the other.

(32) a. #Alice is 35 and she's older than 30.
b. #Alice is older than 30 and she is 35.

Does inquisitive semantics provide anything new in this respect? In inquisitive semantics, one and the same conjunction operation can be applied to both statements and questions. As in standard truth-conditional semantics, this operation amounts to *intersection*: $[\![\mathsf{A}\ \mathsf{and}\ \mathsf{B}]\!] = [\![\mathsf{A}]\!] \cap [\![\mathsf{B}]\!]$.

When conjunction applies to statements, as in (33a), the result is essentially the same as in standard truth-conditional semantics; when it applies to questions, as in (33b), it yields a question which is resolved if and only if both conjuncts are resolved.[21]

(33) a. Alice is from Wales and she is 35.
b. Where is Alice from, and how old is she?

Since the behavior of conjunction when applied to statements is standard, for conjunctive statements we make exactly the same predictions as Katzir and Singh's original account. However, the move to the inquisitive setting allows us to extend these predictions to conjunctions of questions, such as the following.

(34) a. #Is Alice 35, and how old is she?
b. #How old is Alice, and is she 35?

Consider (34a): let $\mathcal{Q}$ be the question whether Alice is 35, and $\mathcal{Q}'$ the question how old Alice is. In order to support $\mathcal{Q}$, an information state must establish that Alice's age is 35, or that her age is not 35; in order to support $\mathcal{Q}'$, it must establish exactly what Alice's age is. But notice that establishing Alice's age implies establishing whether this age is 35 or not. This means that any information state that supports $\mathcal{Q}'$ also supports $\mathcal{Q}$. As a consequence, the states that support both $\mathcal{Q}$ and $\mathcal{Q}'$ are simply those that support $\mathcal{Q}'$. But this means that we have $[\![\mathcal{Q}\ \mathsf{and}\ \mathcal{Q}']\!] = [\![\mathcal{Q}']\!]$. Thus, (34a) contains a redundant occurrence of conjunction, which accounts for the oddness of this question. An identical story can be told to explain the infelicity of (34b).[22]

[21] For a more comprehensive discussion of the treatment of conjunction in inquisitive semantics, see, e.g., Ciardelli *et al.* (2015); Ciardelli and Roelofsen (2015).

[22] There are two observations about conjunction that neither Katzir and Singh's original proposal nor its inquisitive extension directly account for. First, there are cases where the order of the conjuncts seems to matter (note that in (32) and (34) we saw cases where order does *not* seem to matter). The following example is from Schlenker (2008):

(i) a. #John resides in Paris and lives in France.
b. John lives in France and resides in Paris.

Second, Mayr and Romoli (2016) draw attention to cases with nested conjunctions like (ii).

(ii) #Mary is beautiful and married, and she is pregnant and married.

Further evidence for the fact that a constraint analogous to Hurford's applies to conjunctions comes from the inferences that can be drawn from sentences like (35) and (36).

(35) The boys are happy and Robin is happy. $\rightsquigarrow$ Robin is not one of the boys

(36) Are the boys happy? And is Robin happy? $\rightsquigarrow$ Robin is not one of the boys

The statement in (35) triggers the inference that Robin is not one of the boys. This inference can be explained based on Katzir and Singh's redundancy principle: in order for (35) to be felicitous, the conjunction in this sentence must not be redundant; but this is only possible if Robin is not one the boys; for, if Robin is one of the boys, the whole conjunction is equivalent to its first conjunct. In a completely analogous way, our extension of Katzir and Singh's account to questions provides an explanation for the fact that the same inference is triggered by the question in (36).

4 Relevance of Hurford's constraint for theories of meaning

In the previous section we have shown that Katzir and Singh's redundancy-based explanation of Hurford's constraint can be extended to questions. In doing so we encountered a difference between inquisitive semantics and alternative semantics. The former facilitates the desired extension in a straightforward way, while the latter doesn't. In this section, we investigate the source of this discrepancy, connecting it to more fundamental features of the two frameworks.

4.1 Hurford's constraint and semantic structure

Just like in truth-conditional semantics, the most fundamental logical relation between sentences in inquisitive semantics is *entailment*. Moreover, just like in truth-conditional semantics, entailment in inquisitive semantics still amounts to meaning inclusion: $\mathsf{A} \models \mathsf{B} \iff [\![\mathsf{A}]\!] \subseteq [\![\mathsf{B}]\!]$. Finally, again just like in truth-conditional semantics, the space of all meanings in inquisitive semantics ordered by entailment forms a *lattice*. That is, every two meanings $[\![\mathsf{A}]\!]$ and $[\![\mathsf{B}]\!]$ have a greatest lower bound (*meet*) with respect to entailment, namely their intersection $[\![\mathsf{A}]\!] \cap [\![\mathsf{B}]\!]$, and a least upper bound (*join*), namely their union $[\![\mathsf{A}]\!] \cup [\![\mathsf{B}]\!]$.[23] In truth-conditional semantics, this structural feature of the space of meanings is crucially exploited in the treatment of conjunction and disjunction. Namely, a conjunction A and B is taken to express the *meet* of $[\![\mathsf{A}]\!]$ and $[\![\mathsf{B}]\!]$, and a disjunction A or B is taken to express the *join* of $[\![\mathsf{A}]\!]$ and $[\![\mathsf{B}]\!]$. Since the space of meanings in inquisitive semantics still forms a lattice, precisely the same treatment of conjunction and disjunction can be given in this setting. So, while inquisitive semantics enriches the truth-conditional semantic framework, it retains its fundamental structural features, and therefore also allows us to preserve the essence of the truth-conditional treatment of conjunction and disjunction.

Now, as discussed in detail in Roelofsen (2013a); Ciardelli and Roelofsen (2015), this is not so for alternative semantics, where the standard notion of entailment as inclusion does not give the right results, and has not been replaced by a suitable alternative notion. As a consequence, the principled treatment of conjunction and disjunction as expressing *meet* and *join* operations with respect to entailment is lost. While disjunction is still taken to yield the *union* of the alternative sets associated with the two disjuncts, this operation no longer has the same status and the same logical properties as in truth-conditional and in inquisitive semantics. In the case of conjunction, the

We refer to Katzir and Singh (2013) and Mayr and Romoli (2016) for further discussion.

[23] The greatest lower bound of two meanings with respect to entailment is the weakest meaning that entails both, and their least upper bound is the strongest meaning that is entailed by both. For more elaborate discussion of these notions in the context of inquisitive semantics, see Roelofsen (2013a).

situation is even more problematic—taking conjunction to express intersection leads to undesirable results even for the most basic cases (see Ciardelli and Roelofsen, 2015, for concrete examples).

These considerations are of a more abstract nature than the ones that we have been concerned with above. Upon closer examination, however, they bring out precisely those structural features of inquisitive semantics that are responsible for its success in accounting for Hurford's constraint in terms of redundancy. Let us see why.

Consider an arbitrary space of meanings $\mathcal{M}$ ordered by a suitable relation of semantic strength $\leq$. Suppose the space $\langle \mathcal{M}, \leq \rangle$ is a lattice, that is, suppose any two meanings $M, M' \in \mathcal{M}$ have a *meet* and a *join*, which we will denote by $M \wedge M'$ and $M \vee M'$ respectively. If our semantics is based on such a space of meanings, then we can say that a sentence A entails a sentence B just in case the meaning of A is at least as strong as the meaning of B:

$$\mathsf{A} \models \mathsf{B} \iff [\![\mathsf{A}]\!] \leq [\![\mathsf{B}]\!]$$

Moreover, we can associate conjunction and disjunction with the two lattice operations:

$$[\![\mathsf{and}]\!] = \lambda M.\lambda M'.\, M \wedge M' \qquad\qquad [\![\mathsf{or}]\!] = \lambda M.\lambda M'.\, M \vee M'$$

Now, it follows from the very definition of the *join* operation that, if $M \leq M'$, then $M \vee M' = M'$. Thus, if our semantics is based on a space of meanings that constitutes a lattice, and if disjunction is taken to express the *join* operation in this space, this is sufficient to predict redundancy in Hurford configurations:[24]

$$\text{if } \mathsf{A} \models \mathsf{B}, \text{ then } [\![\mathsf{A\ or\ B}]\!] = [\![\mathsf{A}]\!] \vee [\![\mathsf{B}]\!] = [\![\mathsf{B}]\!]$$

Both truth-conditional semantics and inquisitive semantics instantiate this general scheme: in both cases, semantic strength is captured by inclusion, and the *join* operation amounts to set-theoretic union. Thus, in truth-conditional and inquisitive semantics, Hurford disjunctions are redundant for the same fundamental reason: they involve a *join* operation on two arguments one of which is stronger than the other.

This does not hold for alternative semantics. As we saw, the most fundamental problem is that it is not clear how meanings should be compared in this setting, i.e., how they should be ordered in terms of semantic strength. But suppose we manage to define a suitable ordering $\leq$ after all. For basic clauses, whose meaning is a singleton set of propositions, we would want entailment to reduce to the classical notion: $\{|\mathsf{A}|\} \leq \{|\mathsf{B}|\} \iff |\mathsf{A}| \subseteq |\mathsf{B}|$. But then, alternative semantics disjunction cannot be a *join* operation. For, suppose that $|\mathsf{A}| \subset |\mathsf{B}|$. Then the least upper bound of $\{|\mathsf{A}|\}$ and $\{|\mathsf{B}|\}$ would be $\{|\mathsf{B}|\}$, but alternative semantics disjunction yields $\{|\mathsf{A}|\} \cup \{|\mathsf{B}|\} = \{|\mathsf{A}|, |\mathsf{B}|\} \neq \{|\mathsf{B}|\}$. Thus, the fact that alternative semantics does not predict redundancy in Hurford disjunctions is directly connected to the fact that the account of disjunction as a *join* operation is not preserved.

4.2 Hurford effects and the nature of alternatives

While both alternative semantics and inquisitive semantics associate sentences with sets of propositional alternatives, the notion of alternatives is conceptually quite different in the two cases.

In alternative semantics, the notion of a propositional alternative is a primitive notion and there are no constraints on which kinds of sets of propositions count as proper sets of alternatives. In inquisitive semantics, on the other hand, alternatives are defined in terms of the more basic notion

[24] Likewise, if conjunction is taken to express the *meet* operation, redundancy is automatically predicted when one conjunct is stronger than the other. As a consequence, the infelicity of such cases can also be explained in terms of redundancy in any lattice-based semantics.

of *support*: the alternatives associated with a sentence are those propositions that support the sentence in a minimal way. This characterization implies that sets of alternatives have to be of a particular form: two alternatives are always logically independent, that is, one is never contained in the other.

Let us refer to sets of propositions whose elements are pairwise logically independent as *non-nested sets*. In inquisitive semantics, then, unlike in alternative semantics, only non-nested sets of propositions are regarded as proper sets of alternatives. Thus, in a sense, more meanings are available in alternative semantics than in inquisitive semantics.

However, these additional meanings, i.e., nested sets of alternatives, seem impossible to express in languages like English. In principle, a Hurford disjunction would be exactly the right kind of construction to express a nested set of alternatives. But we have seen above that such disjunctions are felicitous only if they can be re-interpreted in such a way that their set of alternatives actually becomes non-nested, and that, if such re-interpretation is possible, the resulting non-nested set constitutes the only available interpretation for the disjunction.

This seems to indicate that there is something wrong with nested sets of alternatives as meanings: the sentences that are supposed to express such sets are either infelicitous, or re-interpreted as expressing non-nested sets of alternatives. From the perspective of alternative semantics, this is puzzling, since nested sets of alternatives are just as good as non-nested sets.

In inquisitive semantics, the puzzle does not arise, because nested sets of alternatives are not available in the first place. Importantly, notice that such sets are not ruled out by some special purpose constraint: rather, it simply follows from the way alternatives are construed in inquisitive semantics that they are never nested. This means that from the perspective of inquisitive semantics, what is special about Hurford disjunctions is not that they express some distinguished class of meanings, but rather that they involve redundant disjuncts, which fail to contribute an alternative to the meaning of the disjunction. As we discussed, this is precisely what makes it possible to explain the need for re-interpretation and, in case this is not possible, the infelicity of such disjunctions.

5 Conclusion

We hope to have achieved two things in this paper. First, we hope to have demonstrated the relevance of inquisitive semantics for the theory of Hurford disjunctions: a more general account of Hurford effects, as they occur both in statements and in questions, becomes available if we combine the theories of Katzir and Singh (2013) and Chierchia *et al.* (2009) with an inquisitive account of disjunction—a result that seems difficult to obtain based on other existing accounts of disjunction. Of particular importance here is that, in its treatment of disjunction, inquisitive semantics strikes a subtle balance between truth-conditional semantics and alternative semantics.

Second, we hope to have shown how the concrete empirical discrepancy between inquisitive semantics and alternative semantics in the domain of Hurford disjunctions is connected to some more abstract and more fundamental differences between the two frameworks. One of these differences concerns the structure of the underlying semantic space: the essential structural features of the semantic space assumed in truth-conditional semantics are preserved in inquisitive semantics, but not in alternative semantics. The other difference that we discussed concerns the notion of propositional alternatives: in alternative semantics this is a primitive, unconstrained notion; on the other hand, in inquisitive semantics, alternatives are characterized in terms of the more basic semantic notion of support, and it follows from this characterization that sets of alternatives have to have a certain form—namely, one alternative can never be nested in another. We argued that both of these more abstract differences between the two frameworks are directly connected to the different predictions that they yield about Hurford disjunctions. Thus, besides contributing to the theory of Hurford disjunctions as such, we hope to have illustrated that more abstract features of a semantic framework are not just important from a logical and philosophical point of view, but can also be crucial to its empirical success.

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